Two More Moon Tracking Computer Programs

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The first moon tracking computer program included here was
rewritten from WA1JXN/WA3GPL and K5JL versions presented in earlier
issues of the EME notes. Warren Butler, W2WD, wrote the program for
TRS-80 level II BASIC(16K). Cassette copies of the program are
available from Warren for the cost of the cassette and postage
(approximately $1.00).

The second program was written in FORTRAN IV by Geoffrey Grayer,
G3NAQ. Again the WA1JXN/WA3GPL program served as the starting point
for this effort.

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10  '              COOROINATES OF THE MOON
20  PRINT
30  ' DISLAYS GHA, DECLINATION, AZIMUTH, ELEVATION OF THE MOON
40  ' FROM A SELECTED LATITUDE, LONGITUOE FOR SELECTED DATES
50  ' ANO TIMES (GMT).   EASTERN STANDARO TIME IS SHOWN BUT CAN BE CHANGEO--
60  ' @ LINE 2040, CHANGE 500 TO TIME DIFFERENTIAL DESIRED--
70  ' EG., FOR PACIFIC STANDARD TIME, USE 800 IN PLACE OF 500.
80  ' @ LINES 850 & 860 CHANGE EST TO TIME ZONE DESIRED--
90  ' EG., REPLACE EST WITH PST FOR THE EXAMPLE BEING USED.
100 ' HARDCOPY OUTPUT CAN BE SELECTEO IF PRINTER IS AVAILABLE;
110 ' OTHERWISE, DATA WILL BE DISPLAYED ON CRT ONLY.
120 PRINT
130 ' BASED ON PROGRAMS BY LANCE COLLISTER, WA1JXN/WA3GPL ANO
140 ' JAY LIEBMANN, K5JL.
150 ' MODIFIED FOR TRS-80 LEVEL II BASIC (16K) BY WARREN BUTLER,W2WO
160 PRINT                                                  (4/4/79).
170 ' DATA FOR UP TO 31 OAYS CAN BE REQUESTED---EACH TIME THE
180 ' COMPUTER ASKS FOR AN INPUT BY PRINTING ?, ENTER DATA IN
190 ' THE FORMAT REQUESTED.  AFTER THE LAST INPUT, INSERT ZEROS
200 ' IN THE SAME FORMAT.
210 ' ANSWER OTHER QUESTIONS AS APPROPRIATE
220 ' UNIVERSAL WINOOWS ARE SHOWN BY LETTERS FOLLOWING DEC VALUES
230 ' U = EUROPEAN UNIVERSAL WINDOW
240 ' W = W/VE UNIVERSAL WINDOW
250 ' J = J/VK/ZL UNIVERSAL WINDOW
260 CLEAR 500
270 DIM F(31),V(31),Y(31),Q(31),S(31)
280  P5=2.000000000*3.1415926535
290  D5=360.0000000000/P5
300 R5=P5/360.0000000000
310 CLS:PRINT:PRINT:PRINT:PRINT"WHAT ARE THE STATION CALL LETTERS";
320 INPUT W$
330 PRINT"WHAT IS YOUR LATITUDE IN DEGREES, MINUTES";
340 INPUT L5,U5
350 PRINT"WHAT IS YOUR LONGITUDE IN DEGREES, MINUTES";
360 INPUT L6,U6
370  L5=(L5+U5/60)*R5
380  L6=(L6+U6/60)*R5
390 PRINT"WHAT IS THE OESIREO PRINTING INCREMENT IN MINUTES";
400 INPUT I
410 INPUT"OO YOU ONLY WANT PRINTOUT WHEN THE MOON IS NEAR THE HORIZON
        O)";B$                                                     (YES;
430 IF B$="YES" THEN 460
440 LET I6=100
450 GOTO 550
460 INPUT"BELOW WHAT ELEVATION IN DEGREES DO YOU WANT PRINTOUT";I6
470 INPUT"OO YOU WANT HAROCOPY PRINTOUT (YES/NO)";WW$
480 PRINT"WHAT ARE THE GMT MONTH, DAY, YEAR DESIREO?"
490 PRINT"USE FORMAT MM,DD,YYYY ---- 4-DIGITS FOR YEAR"
500 FOR N=1 TO 31
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```
510  INPUT F(N), V(N), Y(N)
520  IF F(N)=Ø THEN 64Ø
530  NEXT N
540  GOTO 5ØØ
550  INPUT"DO YOU WANT HARDCOPY (YES/NO)";WW$
560  PRINT
570  PRINT"WHAT ARE THE GMT MONTH, DAY, YEAR, TIME BEGINNING, TIME ENDING?"
580  PRINT"USE THE FORMAT MM,DD,YYYY,TTTT,TTTT
REMINDER --- USE 4 DIGITS FOR YEAR!"
590  FOR N=1TO31
600  INPUT F(N), V(N), Y(N), Q(N), S(N)
610  IF F(N)=Ø THEN 64Ø
620  NEXT N
630  GOTO 59Ø
640    N5=N-1
650  FOR N=1 TO N5
660  IF B$="YES" THEN 68Ø
670  GOTO 71Ø
680    E1=24ØØ
69Ø  B=Ø
7ØØ  GOTO 73Ø
71Ø    E1=S(N)
72Ø    B=Q(N)
73Ø    M=F(N)
74Ø    D=V(N)
75Ø    Y=Y(N)
76Ø    Y1=Y-(INT(Y/1ØØ)*1ØØ)
77Ø  PRINT
78Ø  IF WW$="YES" LPRINT
79Ø  PRINT:CLS
8ØØ  IF WW$="YES" LPRINT
81Ø  PRINT"POSITION OF THE MOON ON ";M;"/";D;"/";Y1;" GMT FROM"" "W$
82Ø  IF WW$="YES" LPRINT"POSITION OF THE MOON ON ";M;"/";D;"/";Y1;" GMT FROM"" "W
     $
83Ø  PRINT
84Ø  IF WW$="YES" LPRINT
85Ø  PRINT"GMT"TAB(11)"GHA"TAB(21)"DEC"TAB(35)"EST"TAB(47)"AZ"TAB(57)"EL"
86Ø  IF WW$="YES" LPRINT"GMT"TAB(11)"GHA"TAB(21)"DEC"TAB(35)"EST"TAB$47)"AZ"TAB(5
     7)"EL"
87Ø  PRINT
88Ø  IF WW$="YES" LPRINT
89Ø  I1=2
9ØØ  IF M>=3 THEN 98Ø
91Ø  IF INT((Y-1853)/4)<11 THEN 94Ø
92Ø    C1=-1
93Ø  GOTO 95Ø
94Ø  C1=Ø
95Ø    J1=365*(Y-1853)+D+3Ø*(M+9)+INT((M+1Ø)/2)
96Ø  J2=INT((Y-1853)/4)+1+C1
97Ø  GOTO 1Ø9Ø
98Ø  IF INT((Y-1852)/4)<11 THEN 1Ø1Ø
99Ø  C1=-1
1ØØØ  GOTO 1Ø2Ø
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4

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1010   C1=0
1020  IF M=9 THEN 1060
1030  IF M=11 THEN 1060
1040  C2=0
1050  GOTO 1070
1060   C2=1
1070  J1=365*(Y-1852)+D+30*(M-3)+INT((M-2)/2)
1080   J2=INT((Y-1852)/4)+C1+C2
1090  J=J1+J2
1100  T1=J-17472.5
1110  D9=(B-INT(B/100)*100)+INT(B/100)*60
1120  D6=(E1-INT(E1/100)*100)+INT(E1/100)*60
1130  D7=D9-D6
1140  D8=D7-I
1150  IF D7>0 THEN 1170
1160  GOTO 1190
1170  IF D8>=0 THEN 2150
1180  B=E1
1190  T=(B-INT(B/100)*100)/1440+INT(B/100)/24
1200  T5=T1+T
1210  K1=((.751213+.036601102*T5)-INT(.751213+.036601102*T5))*P5
1220  K2=((.822513+.0362916457*T5)-INT(.822513+.0362916457*T5))*P5
1230  K3=((.995766+.00273777852*T5)-INT(.995766+.00273777852*T5))*P5
1240  K4=((.974271+.0338631922*T5)-INT(.974271+.0338631922*T5))*P5
1250  K5=((.0312525+.0367481957*T5)-INT(.0312525+.0367481957*T5))*P5
1260  L8=K1+.658*R5*SIN(2*K4)+6.289*R5*SIN(K2)
1270  L8=L8-1.274*R5*SIN(K2-2*K4)-.186*R5*SIN(K3)
1280  L8=L8+.214*R5*SIN(2*K2)-.114*R5*SIN(2*K5)
1290  L8=L8-.059*R5*SIN(2*K2-2*K4)-.057*R5*SIN(K2+K3-2*K4)
1300  K6=K5+.6593*R5*SIN(2*K4)+6.2303*R5*SIN(K2)-1.272*R5*SIN(K2-2*K4)
1310  L7=5.144*R5*SIN(K6)-.146*R5*SIN(K5-2*K4)
1320  LET D1=COS(L7)*SIN(L8)*.397821+SIN(L7)*.917463
1330  LET D1=ATN(D1/(SQR(1-D1↑2)))
1340  G1=50+.5+((D1)/(.792))*D5
1350  G2=80+((D1)/(.808))*D5
1360  G3=141.5-((D1)*(.738)*D5)
1370  G4=170.5-((D1)*(.857)*D5)
1380  A2=COS(L7)*COS(L8)/COS(D1)
1390  A1=(COS(L7)*SIN(L8)*.917463-SIN(L7)*.397821)/COS(D1)
1400  A=ATN(A1/A2)
1410  GOSUB 1670
1420  R1=A
1430  L1=.065709822*T1
1440  L=T*24*1.02738+6.646055+(L1-INT(L1/24)*24)
1450  L=(L-INT(L/24)*24)
1460  G=(L/24)*P5-R1
1470  IF G<P5 THEN 1500
1480  G=G-P5
1490  GOTO 1530
1500  IF G<0 THEN 1520
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```
1510  GOTO 1530
1520  G=G+P5
1530  H=L6-G
1540  E3=COS(L5)*COS(H)*COS(D1)+SIN(D1)*SIN(L5)
1550  E2=SQR(1-(E3*E3))
1560  E=ATN((E3/E2)-(1/(61.33*E2)))
1570  F=ATN(E3/E2)
1580  IF E<0 THEN 2100
1590  IF E>I6*R5 THEN 2100
1600  A2=SIN(D1)/(COS(L5)*COS(F))
1610  A2=A2-(SIN(L5)/COS(L5))*(SIN(F)/COS(F))
1620  A1=SIN(L5)*SIN(D1)+COS(L5)*COS(DI)*COS(H)
1630  A1=(SIN(H)*COS(D1))/SQR(1-A1±2)
1640  A=ATN(A1/A2)
1650  GOSUB 1670
1660  GOTO 1820
1670  IF A=0 THEN 1690
1680  GOTO 1730
1690  IF A2<0 THEN 1710
1700  GOTO 1810
1710  A=P5/2
1720  GOTO 1810
1730  IF A>0 THEN 1790
1740  IF A2<0 THEN 1770
1750  A=P5+A
1760  GOTO 1810
1770  A=P5+(A-P5/2)
1780  GOTO 1810
1790  IF A2=>0 THEN 1810
1800  A=A+P5/2
1810  RETURN
1820  IF (T-I1)>(2*I)/1440 THEN 1840
1830  GOTO 1850
1840  PRINT
1850  BS=INT(B+.5):BS$="::::##"
1860  Z1=INT(A*D5*10+.5)/10
1870  Z2=INT(E*D5*10+.5)/10
1880  Z3=INT(G*D5*10+.5)/10
1890  Z4=INT(D1*D5*10+.5)/10
1900  IF Z4<0 THEN 2030
1910  IF Z3<G1 THEN 2030
1920  IF Z3>G2 THEN 1940
1930  GOTO 1970
1940  IF Z3<G3 THEN 1990
1950  IF Z3>G4 THEN 2030
1960  GOTO 2010
1970  Y$="U"
1980  GOTO 2040
1990  Y$="W"
2000  GOTO 2040
```

```
2010  Y$="J"
2020  GOTO 2040
2030  Y$=" "
2040  ES=(INT(B+.5))-500
2050  IFES<=0THENES=ES+2400
2060  ES$="::::##"
2070  PRINTUSINGBS$;BS;:PRINTTAB(10)Z3TAB(20)Z4;Y$TAB(35)USINGES$;ES;:PRINTTAB¢45
      )Z1TAB(55)Z2
2080  IF WW$="YES" LPRINTUSINGBS$;BS;:LPRINTTAB(10)Z3TAB(20)Z4;Y$TAB¢35)USINGES$;
      ES;:LPRINTTAB(45)Z1TAB(55)Z2
2090  I1=T
2100  B=B+I
2110  Z=(B-INT(B/100)::100)-60
2120  IF Z<0 THEN 1110
2130  B=INT(B/100)::100+100+Z
2  0  GOTO 1110
2150  NEXT N
2160  N=0
2170  PRINT
2180  PRINT
2190  PRINT"DO YOU WANT MORE INFORMATION (YES/NO)";
2200  INPUT D$
2210  IF D$="YES" THEN 280
2220  END
```

POSITION OF THE MOON ON 5 / 19 / 79   GMT FROM W2WD

GMT	GHA	DEC	EDT	AZ	EL
*615	357.4	-10	*215	106	2.2
*630	1	-9.9	*230	108.4	4.9
*645	4.6	-9.9	*245	110.8	7.5
*700	8.2	-9.8	*300	113.4	10.1
*715	11.8	-9.8	*315	115.9	12.6
*730	15.4	-9.8	*330	118.6	15.1
*745	19.1	-9.7	*345	121.3	17.5
*800	22.7	-9.7	*400	124.2	19.8
*815	26.3	-9.6	*415	127.2	22.1
*830	29.9	-9.6	*430	130.3	24.3
*845	33.5	-9.6	*445	133.5	26.4
*900	37.1	-9.5	*500	136.9	28.4
*915	40.8	-9.5	*515	140.4	30.3
*930	44.4	-9.4	*530	144.1	32
*945	48	-9.4	*545	147.9	33.6
1000	51.6	-9.4	*600	151.9	35
1015	55.2	-9.3	*615	156.1	36.2
1030	58.8	-9.3	*630	160.4	37.3
1045	62.5	-9.2	*645	164.8	38.2
1100	66.1	-9.2	*700	169.3	38.8
1115	69.7	-9.1	*715	174	39.3
1130	73.3	-9.1	*730	178.6	39.5
1145	76.9	-9.1	*745	183.3	39.5
1200	80.5	-9	*800	188	39.3
1215	84.2	-9	*815	192.6	38.8
1230	87.8	-8.9	*830	197.1	38.2
1245	91.4	-8.9	*845	201.5	37.3
1300	95	-8.9	*900	205.8	36.2
1315	98.6	-8.8	*915	210	35
1330	102.2	-8.8	*930	214	33.5
1345	105.9	-8.7	*945	217.9	31.9
1400	109.5	-8.7	1000	221.5	30.2
1415	113.1	-8.6	1015	225.1	28.3
1430	116.7	-8.6	1030	228.5	26.4
1445	120.3	-8.6	1045	231.7	24.3
1500	123.9	-8.5	1100	234.8	22.1
1515	127.6	-8.5	1115	237.8	19.8
1530	131.2	-8.4	1130	240.7	17.5
1545	134.8	-8.4	1145	243.5	15.1
1600	138.4	-8.4	1200	246.2	12.6
1615	142	-8.3	1215	248.8	10.1
1630	145.6	-8.3	1230	251.4	7.6
1645	149.3	-8.2	1245	253.9	4.9
1700	152.9	-8.2	1300	256.3	2.3

```
        C
        C   THIS PROGRAM IS DESIGNED TO CALCULATE THE AZIMUTH AND ELEVATION OF THE MOON
        C
        C   THIS IS A FORTRAN VERSION OF PROGRAM 3 OF THE EIMAC EME NOTE AS-49-6
        C   ORIGINALLY WRITTEN BY LANCE COLLISTER WA3GPL, CONVERTED BY GEOFF GRAYER G3NAQ.
        C
        C   THE INPUT FORMAT IS AS FOLLOWS...
        C
        C   FIRST DATA CARD:
        C   OPTIONAL IDENTIFICATION (A10), LAT. OF STATION DEGS.(I10), LAT. OF STATION
        C   MINS. (I10), LONG. OF STATION DEGS. (I10), LONG. OF STATION MINS. (I10).
        C
        C   SECOND AND SUBSEQUENT DATA CARDS:
        C   YEAR (I10), MONTH (I10), DAY (I10), START HRS.MINS.(I10), STOP HRS.MINS.(I10)
        C   TIME INCREMENT MINS.(I10) - DEFAULT 10 MINS., MAXIMUM ELEVATION DEGS. (I10) -
        C   MAY BE USED TO SELECT PRINTOUT ONLY WHEN THE MOON IS NEAR THE HORIZON -
        C   DEFAULT 90 DEGS.
        C
        C   ALL TIMES ARE IN GMT USING THE 0000 TO 2400 HOUR SYSTEM.
        C
        C   A BLANK CARD DENOTES THE END OF THE DATA SET AND TERMINATES THE PROGRAM.
        C
        C   PRINTOUT IS SUSPENDED WHENEVER THE ELEVATION OF THE MOON IS NEGATIVE.
        C
        C   FOR FURTHER INFORMATION, REFER TO THE EIMAC NOTE.
        C
        C                                           GEOFFREY H. GRAYER G3NAQ
        C                                           BRIGHTWALTON, BERKSHIRE
        C                                           APRIL, 1978
        C
        CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        C
0001              INTEGER D,Y,C1,C2,B,Z,E1,D6,D7,D8,D9,GMT
0002              REAL    PI,P5,D5,R5,K1,K2,K3,K4,K5,L8,K6,L7,D1,A1,A2,A,L1,L,E3,E2
0003              REAL    L5,L6,I1
0004              REAL*4  J0
0005              DIMENSION IDENT(10),GMT(4)
0006              FNA(X)=AINT(X*D5*10.+0.5)/10.
0007              FNB(X)=(X-AINT(X))*P5
0008              PI=3.1415926535
0009              P5=2.*PI
0010              D5=180./PI
0011              R5=PI/180.
        C READ STATION IDENT, LAT DEGS, LAT MINS, LONG DEGS, LONG MINS
0012              READ (5,1) IDENT,LATD,LATM,LONGD,LONGM
0013            1 FORMAT (10A1,4I10)
0014              L5=(LATD+LATM/60.)*R5
0015              L6=(LONGD+LONGM/60.)*R5
0016           10 CONTINUE
        C READ YEAR,MONTH,DAY,(START TIME GMT),(END TIME GMT),(TIME INCREMENT MINS),
        C    (MAXIMUM ELEVATION DEGS )
0017              READ (5,2) Y,M,D,B,E1,I,I6
0018            2 FORMAT(7I10)
0019              IF(Y.EQ.0) STOP
0020              IF(I.EQ.0) I=10
0021              IF(I6.EQ.0) I6=100
0022              IF(E1.EQ.0) E1=2400
0023              I1=2
        C CALCULATE JULIAN DATE
0024              IF (M.GE.3) GO TO 16
0025              C1=-1
0026              IF(((Y-1853)/4).LT.11) C1=0
0027              J1=365*(Y-1853) + 30*(M+9) + ((M+10)/2) + D
0028              J2=((Y-1853)/4) + C1 + 1
0029              GO TO 27
0030           16 C1=-1
0031              IF (((Y-1852)/4).LT.11) C1=0
0032              IF (M.EQ.9.OR.M.EQ.11) GO TO 24
0033           22 C2=0
0034              GO TO 25
0035           24 C2=1
0036           25 J1=365*(Y-1852) + 30*(M-3) + ((M-2)/2) + D
0037              J2= ((Y-1852)/4) + C1 + C2
0038           27 J=J1+J2
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9

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0039              T1=FLOAT(J)-17472.5
0040              JD=FLOAT(J)+2397547.5
0041              WRITE (6,3) IOENT,LATO,LATM,LONGO,LONGM,Y,M,O,JD
0042            3 FORMAT ('1LUNAR COOROINATES FOR ',10A1/' STATION  LAT: ',2I4,'
0043             +LONG: ',2I4/' OATE   ',I4,'/',I2,'/',I2,'   JD=',F12.1//)
0043              WRITE(6,5)
0044            5 FORMAT('    GMT       AZ      EL      GHA        DEC'/)
0045           29 09=B - (B/100)*100 + (B/100)*60
0046              D6= E1 - (E1/100)*100 + (E1/100)*60
0047              D7=D9-06
0048              D8=D7-I
0049              IF(D7.LE.0) GO TO 38
0050              IF(D8.GE.0) GO TO 10
0051              B=E1
     C CALCULATE LUNAR LAT AND LONG
0052           38 T=FLOAT(B-(B/100)*100)/1440.+FLOAT(B/100)/24.
0053              T5=T1+T
0054              K1=FNB(0.751213+0.036601102*T5)
0055              K2=FNB(0.822513+0.0362916457*T5)
0056              K3=FNB(0.995766+0.00273777852*T5)
0057              K4=FNB(0.974271+0.0338651922*T5)
0058              K5=FNB(0.0312525+0.036748195T*T5)
0059              L8=K1+0.658*R5*SIN(2.*K4)+6.289*R5*SIN(K2)
0060              L8=L8-1.274*R5*SIN(K2-2.*K4)-0.186*R5*SIN(K3)
0061              L8=L8+0.214*R5*SIN(2.*K2)-0.114*R5*SIN(2.*K5)
0062              L8=L8-0.059*R5*SIN(2.*K2+2.*K4)-0.057*R5*SIN(K2+K3-2.*K4)
0063              K6=K5+.6593*R5*SIN(2.*K4)+6.2303*R5*SIN(K2)-1.272*R5*SIN(K2-2.*K4)
0064              L7=5.144*R5*SIN(K6)-0.146*R5*SIN(K5-2.*K4)
     C CALCULATION OF RA ANO OEC
0065              D1=COS(L7)*SIN(L8)*0.397821+SIN(L7)*0.917463
0066              O1=ATAN2(O1,SQRT(1.-O1**2))
0067              A2=COS(L7)*COS(L8)/COS(D1)
0068              A1=(COS(L7)*SIN(L8)*0.917463-SIN(L7)*0.397821)/COS(O1)
0069              A=ATAN2(A1,A2)
0070              R1=A
0071              L1=0.065709822*T1
0072              L=T*24.*1.002738+6.646055+(L1-AINT(L1/24)*24.)
0073              L=(L-AINT(L/24)*24)
     C CALCULATION OF GREENWICH HOUR ANGLE G FROM LOCAL SIDERIAL TIME
0074              G=(L/24)*P5-R1
0075              IF(G.LT.P5) GO TO 67
0076              G=G-P5
0077              GO TO 71
0078           67 IF(G.LT.0.) GO TO 69
0079              GO TO 71
0080           69 G=G+P5
     C CALCULATION OF LOCAL HOUR ANGLE H FROM GHA
0081           71 H=L6-G
     C CALCULATION OF ELEVATION E
0082              E3=COS(L5)*COS(H)*COS(O1)+SIN(D1)*SIN(L5)
0083              E2=SQRT(1-E3**2)
0084              E=ATAN2(E3,E2)
0085              IF(E.LT.0.) GO TO 117
0086              IF(E.GT.(16*R5)) GO TO 117
     C CALCULATION OF AZIMUTH A
0087              A2=SIN(D1)/(COS(L5)*COS(E))
0088              A2=A2-(SIN(L5)/COS(L5))*(SIN(E)/COS(E))
0089              A1=SIN(L5)*SIN(D1)+COS(L5)*COS(O1)*COS(H)
0090              A1=(SIN(H)*COS(D1))/SQRT(1.-A1**2)
0091              A=ATAN2(A1,A2)
0092              AZ=FNA(A)
0093              EL=FNA(E)
0094              GHA=FNA(G)
0095              OEC=FNA(D1)
0096              GMT(1)=B/1000
0097              GMT(2)=B/100-(B/1000)*10
0098              GMT(3)=B/10-(B/100)*10
0099              GMT(4)=B-(B/10)*10
0100              IF((T-I1).GT.(2.*I/1440.)) WRITE (6,7)
0101            7 FORMAT(1H )
0102          104 WRITE(6,6) GMT,AZ,EL,GHA,DEC
0103            6 FORMAT(3H   ,4I1,4F12.1)
0104              I1=T
0105          117 B=B+I
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```
0106              Z=B-(B/100)*100 - 60
0107              IF(Z.LT.0) GO TO 29
0108              B=(B/100)*100 + 100 + Z
0109              GO TO 29
0110              END
```

LUNAR COORDINATES FOR G3NAQ
STATION LAT: 51   34   LONG: 1   18
DATE 1978/ 5/20   JD=   2443648.0

GMT	AZ	EL	GHA	DEC
0000	-143.7	24.3	34.2	-7.7
0010	-141.3	23.3	36.6	-7.7
0020	-138.9	22.4	39.0	-7.7
0030	-136.6	21.3	41.5	-7.8
0040	-134.4	20.3	43.8	-7.8
0050	-132.1	19.1	46.3	-7.8
0100	-129.9	18.0	48.7	-7.8
0110	-127.7	16.8	51.1	-7.9
0120	-125.6	15.6	53.4	-7.9
0130	-123.4	14.3	56.0	-7.9
0140	-121.4	13.0	58.4	-7.9
0150	-119.4	11.7	60.7	-8.0
0200	-117.4	10.4	63.1	-8.0
0210	-115.4	9.0	65.5	-8.0
0220	-113.3	7.6	68.0	-8.0
0230	-111.5	6.2	70.4	-8.1
0240	-109.6	4.8	72.8	-8.1
0250	-107.6	3.3	75.2	-8.1
0300	-105.8	1.9	77.6	-8.2
0310	-103.9	0.4	80.0	-8.2
1720	107.2	0.1	285.0	-10.5
1730	109.1	1.5	287.4	-10.5
1740	111.0	2.8	289.7	-10.5
1750	113.0	4.2	292.1	-10.6
1800	114.9	5.5	294.6	-10.6
1810	116.9	6.9	297.1	-10.6
1820	118.9	8.1	299.4	-10.6
1830	120.9	9.4	301.8	-10.7
1840	122.9	10.7	304.2	-10.7
1850	125.0	11.9	306.6	-10.7
1900	127.1	13.1	309.0	-10.7
1910	129.2	14.2	311.4	-10.8
1920	131.4	15.4	313.9	-10.8
1930	133.6	16.5	316.3	-10.8
1940	135.8	17.5	318.7	-10.8
1950	138.1	18.5	321.1	-10.9
2000	140.4	19.5	323.5	-10.9
2010	142.7	20.4	325.9	-10.9
2020	145.0	21.2	328.3	-10.9
2030	147.4	22.0	330.8	-11.0
2040	149.9	22.8	333.2	-11.0
2050	152.3	23.5	335.6	-11.0
2100	154.7	24.1	337.9	-11.1
2110	157.3	24.7	340.4	-11.1
2120	159.9	25.2	342.8	-11.1
2130	162.4	25.7	345.1	-11.1
2140	165.0	26.1	347.5	-11.1
2150	167.7	26.4	350.1	-11.1
2200	170.3	26.7	352.5	-11.2
2210	172.8	26.9	354.8	-11.2
2220	175.5	27.0	357.2	-11.2
2230	178.2	27.1	359.7	-11.2
2240	-179.1	27.0	2.0	-11.3
2250	-176.5	27.0	4.4	-11.3
2300	-173.8	26.8	6.8	-11.3
2310	-171.2	26.6	9.3	-11.4
2320	-168.6	26.3	11.7	-11.4
2330	-166.0	26.0	14.1	-11.4
2340	-163.4	25.5	16.5	-11.4
2350	-160.8	25.1	18.9	-11.5
2400	-158.3	24.5	21.3	-11.5